CORRELATION OF COASTAL WATER TURBIDITY AND CIRCULATION WITH ERTS-1 AND SKYLAB IMAGERY

V. Klemas
M. Otley
W. Philpot
C. Wethe

College of Marine Studies
University of Delaware
Newark, DE

R. Rogers

Bendix Aerospace Division
Ann Arbor, MI

presented at the

Ninth International Symposium on
Remote Sensing of Environment
University of Michigan
Ann Arbor, Michigan

April 15-19, 1974

CORRELATION OF COASTAL WATER TURBIDITY AND CIRCULATION WITH ERTS-1 AND SKYLAB IMAGERY

V. Klemas
M. Otley
W. Philpot
C. Wethe
College of Marine Studies
University of Delaware
Newark, DE

R. Rogers
Bendix Aerospace Division
Ann Arbor, MI

ABSTRACT

Imagery and digital tapes from ten successful ERTS-1 passes and one Skylab pass over Delaware Bay during different portions of the tidal cycle have been analyzed with special emphasis on turbidity, current circulation, waste disposal plumes and convergent boundaries between different water masses. (NASA-ERTS-1 I.D. Nos. 1024-15073, 1079-15133, 1133-15141, 1186-15081, 1187-15140, 1205-15141, 1294-15083, 1349-15134, 1385-15131, 1403-15125 and Skylab-EREP pass of September 12, 1973, respectively). During ERTS-1 and Skylab overpasses ground truth was collected with boats and helicopters along three transects across the bay, including measurements of Secchi depth, suspended sediment concentration, transmissivity, temperature, salinity, and water color. Nine major medium and high altitude aircraft overflights were conducted during the same period.

Under atmospheric conditions encountered along the East Coast of the United States, MSS band 5 seemed to give the best representation of sediment load in the upper one meter of the water column. Band 4 was masked by haze-like noise, while band 6 did not penetrate as deeply into the water column. ERTS-1 image radiance (microdensitometer trace) correlated well with Secchi depth and suspended sediment concentration.

Color density slicing of 70mm transparencies helped delineate the suspended sediment patterns more clearly and differentiate turbidity levels. Density slicing of all four MSS bands gave an indication of relative sediment concentration as a function of depth, since the four bands penetrate to different depths ranging from several meters to several centimeters, respectively. Sediment pattern enhancements obtained by additive color viewing of the four ERTS-1 MSS band transparencies did not noticeably improve the contrast beyond that seen in the best band, i.e., MSS band 5. However, digital enhancement techniques produced improved thematic maps.

Current circulation patterns were observed during different parts of the tidal cycle, using suspended sediment as a natural tracer. The current direction in the ERTS-1 imagery agreed well with predicted and measured currents throughout Delaware Bay. During flood tide the suspended sediment as seen from ERTS-1 also correlated with the depth profile since most of turbidity during flood tide seems to be caused by sand particles brought into temporary suspension by currents and waves over shallow parts of the bay. As expected, no such correlation was found during ebb tide, when smaller particles of silt and clay are carried down the river in a state of nearly permanent suspension.

Convergent shear boundaries between different water masses have been observed from ERTS-1, with foam lines containing high concentrations of lead, mercury, and other toxic substances. In several ERTS-1 and Skylab EREP frames, acid disposal plumes have been detected about 40 miles off Delaware's Atlantic coast.

Analysis of Skylab-EREP photographs of September 12, 1973, permitted identification of all water features seen by ERTS-1, with considerably better spatial and spectral resolution.

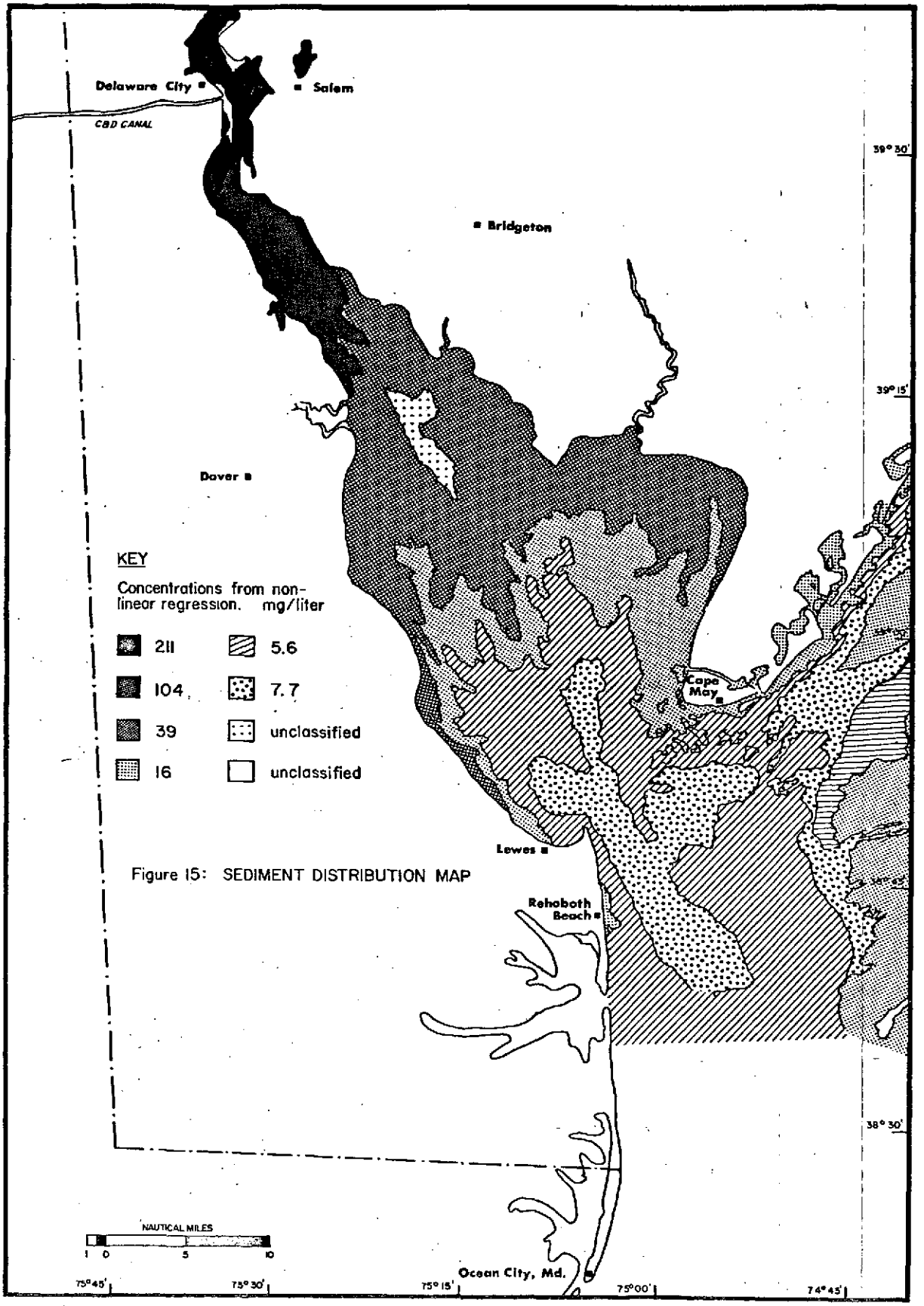

Figure 15: SEDIMENT DISTRIBUTION MAP